JP-2000-066165E

[Title of the Invention] METHOD OF MANUFACTURING LIQUID CRYSTAL DISPLAY PANEL

[Abstract]

[Object] In a method of manufacturing a liquid crystal display panel for dividing a plurality of liquid crystal display panels integrally formed between a pair of substrates, when the panel is divided, pattern forming parts of the liquid crystal display panels adjacent to each other are delaminated together with an intruded sealant, and therefore the pattern forming parts are improperly cut, thus causing yield loss.

[Solving Means] The method includes forming projections and recesses 20 on a glass substrate 1 to surround each liquid crystal display panel 4 formed of an image display part 2 and a sealant 3 surrounding the image display part 2, wherein the projections and recesses 20 prevent the sealant 3 from intruding into the pattern forming part of the adjacent liquid crystal display panel 4 when the glass substrate 1 is adhered to another glass substrate.

[Claims]

[Claim 1] A method of manufacturing a liquid crystal display panel, comprising:

applying a sealant around a plurality of image display

parts between a pair of substrates;

adhering the pair of substrates to each other by forming projections and recesses on the pair of substrates such that the projections and recesses surround each liquid crystal display panel formed of the image display part and the sealant surrounding the image display part;

dividing each liquid crystal display panel, while separating unnecessary parts having the projections and recesses;

injecting a liquid crystal through an injection port formed at the image display part of the divided liquid crystal display panel and sealing the injection port; and

manufacturing a plurality of liquid crystal display panel.

[Claim 2] The method according to Claim 1, wherein the projections and recesses are formed at one of the pair of substrates.

[Claim 3] the method according to claim 1, wherein the projections and recesses are simultaneously formed during processes of forming and etching an insulating layer among processes of forming an array substrate which is one substrate of the pair of substrates, the etching process forming a contact between a gate electrode and a source electrode of a pattern forming part.

[Claim 4] The method according to Claim 3, wherein

grooves are formed at the projections and recesses of the array substrate through an etching process.

[Claim 5] The method according to claim 1, wherein the projections and recesses are simultaneously formed during a process of etching an overcoat layer on the substrate and a color filter among processes of forming a color filter substrate which is the other substrate of the pair of substrates.

[Claim 6] The method according to claim 5, wherein grooves are formed at the projections and recesses of the color filter substrate through an etching process.

[Claim 7] The method according to claim 1,

wherein the projections and recesses are simultaneously formed during processes of forming and etching an insulating layer among processes of forming an array substrate which is one substrate of the pair of substrates, the etching process forming a contact between a gate electrode and a source electrode of a pattern forming part, and

wherein the projections and recesses are simultaneously formed during a process of etching an overcoat layer on the substrate and a color filter among processes of forming a color filter substrate which is the other substrate of the pair of substrates.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a method of manufacturing a liquid crystal display panel for dividing a plurality of liquid crystal display panels integrally formed between a pair of substrates to manufacture a plurality of separated liquid crystal display panels.

[0002]

[Description of the Related Art]

Typically, as shown in a plan view of a liquid crystal display panel in the first step of a manufacturing process of FIG. 5, a method of manufacturing a liquid crystal display panel for dividing a plurality of liquid crystal display panels integrally formed between a pair of substrates to manufacture a plurality of separated liquid crystal display panels includes: applying a sealant 3 around a plurality of image display parts 2 between a pair of glass substrates 1; dividing each liquid crystal display panel 4 formed of the image display part 2 and the sealant 3 surrounding the image display part 2; and injecting a liquid crystal into the image display part 2 of each divided liquid crystal display panel 4 from an injection port 5 formed of the sealant 3 and sealing the injection port 5. However, the sealant 3 applied around the image display part 2 is moved

as shown in FIGS. 6(a), 6(b) and 6(c), taken along line A-A of FIG. 5, which specifically represents each step of the manufacturing process.

[0003]

First, in the first step, as shown in FIG. 6(a), spacers 13 are interposed between a color filter substrate 9 including a glass substrate 1, a color filter 6, an overcoat layer 7 and a transparent electrode 8, and an array substrate 12 including a glass substrate 1, a pattern forming part formed of a thin film transistor, a transparent electrode and an IC mounting part, and an insulating layer 11 to maintain a predetermined gap between the substrates 9 and 12, and then the sealant 3 is applied to hermetically seal the liquid crystal in the image display part 2. The injection port 5 is made using the sealant 3 in order to inject the liquid crystal into the image display part 2 when the sealant 3 is applied. At this time, when the sealant 3 is applied using a dispenser, a seal boat 15 is formed at an outside of the injection port forming part 14, i.e., an unnecessary part between the liquid crystal display panels 4 adjacent to each other.

[0004]

Next, in the second step, as shown in FIG. 6(b), while the sealant 3 is diffused between the color filter substrate 9 and the array substrate 12 by adhering the color filter

substrate 9 and the array substrate 12 to each other in a pressing manner in the state of FIG. 6(a), since the seal boat 15 gathers the sealant 3 to have a large volume in comparison with another seal forming part, when the adjacent liquid crystal display panel 4 has a narrow space, the seal boat 15 at the unnecessary part between the adjacent liquid crystal display panels 4 is leaked to intrude into the pattern forming part 10 of the adjacent liquid crystal panels 4, and an intruded seal part 16 is formed on the pattern forming part 10 of the adjacent liquid crystal display panel 4, thereby causing the sealant 3 to be cured in this state.

[0005]

Next, in the third step, as shown in FIG. 6(c), the liquid crystal display panels are individually divided along the lines B-B, C-C and D-D of FIG. 6(b), divided liquid crystal display panels 17 and 18 are obtained at a left side of the line B-B and a right side of the lines C-C and D-D, and the unnecessary part 19 having the seal boat 15 is separated between the line B-B and the lines C-C and D-D. However, when the unnecessary part 19 is separated, the pattern forming part 10 of the adjacent liquid crystal display panel 4 located under the intruded seal part 16 may be delaminated together with the intruded seal part 16.

[0006]

[Problems to be Solved by the Invention]

As described above, in the conventional method of manufacturing a liquid crystal display panel, when the panel is divided into individual liquid crystal display panels, the pattern forming part of the adjacent liquid crystal display panel may be delaminated together with the intruded seal part of the separated unnecessary part to cause the pattern forming part to be improperly cut, thus causing yield loss.

[0007]

In addition, in order to prevent the seal boat from intruding into the pattern forming part of the adjacent liquid crystal display panel, when a space between the adjacent liquid crystal display panels is widened, a size of the image display part becomes smaller. As a result, the number of liquid crystal display panels that can be divided from one glass substrate becomes smaller.

[0008]

Further, when the patterning speed of the sealant becomes lower, Tact-Time is increased, thereby reducing productivity.

[0009]

In order to solve the above-mentioned problems, an object of the present invention is to provide a method of manufacturing a liquid crystal display panel capable of

increasing productivity, since there is no probability of causing yield loss due to improper cutting of the pattern forming part, when one glass substrate is divided into individual liquid crystal display panels.

[0010]

[Means for Solving the Problems]

In order to accomplish the above-mentioned objects, the present invention provides a method of manufacturing a liquid crystal display panel includes: adhering substrates to each other in the state that projections and recesses are formed at the substrate to surround individual liquid crystal display panels formed of an image display part and a sealant surrounding the image display part so that the projections and recesses prevent the sealant from intruding into a pattern forming part of the adjacent liquid crystal display panel, whereby there is no probability of causing yield loss due to improper cutting of the pattern forming part and it is possible to increase productivity.

[0011]

[Aspects of the Invention]

The invention recited in Claim 1 is a method of manufacturing a liquid crystal display panel comprising: applying a sealant around a plurality of image display parts between a pair of substrates; adhering the pair of substrates to each other after forming projections and

recesses on the pair of substrates such that the projections and recesses surround each liquid crystal display panel formed of the image display part and the sealant surrounding the image display part; dividing each liquid crystal display panel while separating unnecessary parts having the projections and recesses; injecting a liquid crystal through an injection port formed at the image display part of the divided liquid crystal display panel and sealing the injection port; and manufacturing a plurality of liquid crystal display panels, whereby allowing the projections and recesses disposed on the substrate to surround each liquid crystal display panel to prevent the sealant of each liquid crystal display panel from intruding into the adjacent liquid crystal display panel, when the pair of substrates are adhered to each other.

[0012]

The invention recited in Claim 2 is a method of manufacturing a liquid crystal display panel according to Claim 1, wherein the projections and recesses are formed at one of the pair of substrates, whereby allowing the projections and recesses disposed on one substrate to prevent the sealant of each liquid crystal display panel from intruding into the adjacent liquid crystal display panel.

[0013]

The invention recited in Claim 3 is a method of manufacturing a liquid crystal display panel according to claim 1, wherein the projections and recesses are simultaneously formed during processes of forming and etching an insulating layer among processes of forming an array substrate which is one substrate of the pair of substrates, the etching process forming a contact between a gate electrode and a source electrode of a pattern forming part, whereby it is possible to form the projections and recesses simultaneously with forming the insulating layer, and etching the insulating layer during the processes of manufacturing the array substrate.

[0014]

The invention recited in Claim 4 is a method of manufacturing a liquid crystal display panel according to Claim 3, wherein grooves are formed at the projections and recesses of the array substrate through an etching process, whereby allowing the grooves formed on the substrate through etching to more increase a height difference between the projections and recesses, and more decrease a thickness of the substrate at which the etching is performed.

[0015]

The invention recited in Claim 5 is a method of manufacturing a liquid crystal display panel according to claim 1, wherein the projections and recesses are

simultaneously formed during a process of etching an overcoat layer on the substrate and a color filter among processes of forming a color filter substrate which is the other substrate of the pair of substrates, whereby it is possible to form the projections and recesses simultaneously with etching the overcoat layer during the process of manufacturing the color filter substrate.

[0016]

The invention recited in Claim 6 is a method of manufacturing a liquid crystal display panel according to claim 5, wherein grooves are formed at the projections and recesses of the color filter substrate through an etching process, whereby allowing the grooves formed on the substrate through etching to more increase a height difference between the projections and recesses, and more decrease a thickness of the substrate at which the etching is performed.

[0017]

The invention recited in Claim 7 is a method of manufacturing a liquid crystal display panel according to claim 1, wherein the projections and recesses are simultaneously formed during processes of forming and etching an insulating layer among processes of forming an array substrate which is one substrate of the pair of substrates, the etching process forming a contact between a

gate electrode and a source electrode of a pattern forming part, and wherein the projections and recesses are simultaneously formed during a process of etching an overcoat layer on the substrate and a color filter among processes of forming a color filter substrate which is the other substrate of the pair of substrates, whereby allowing the projections and recesses simultaneously formed on the array substrate and the color filter substrate during each substrate forming process to prevent the sealant of each liquid crystal display panel from intruding into the adjacent liquid crystal display panel.

[0018]

An embodiment of the present invention will be described with reference to the attached drawings.

[Embodiments]

FIG. 1 is a plan view of a liquid crystal display panel in a first step of a method of manufacturing the liquid crystal display panel in accordance with an embodiment of the present invention. Hereinafter, like reference numerals refer to like elements in FIGS. 5 and 6 representing the conventional art.

[0019]

In accordance with an embodiment of the present invention for manufacturing a plurality of individual liquid crystal display panels by dividing a plurality of liquid

crystal display panels integrally formed between a pair of substrates, a method of manufacturing a liquid crystal display panel comprises: applying a sealant 3 around a plurality of image display parts 2 between a pair of glass substrates 1; adhering the pair of glass substrates 1 to each other after forming projections and recesses 20 on the pair of substrates 1 such that the projections and recesses 20 surround each liquid crystal display panel 4 formed of the image display part 2 and the sealant 3 surrounding the image display part 2; dividing each liquid crystal display panel 4 while separating unnecessary parts having the projections and recesses 20; injecting a liquid crystal through an injection port 5 formed of the sealant 3 at the image display part 2 of the divided liquid crystal display panel 4 and sealing the injection port 5; and manufacturing a plurality of liquid crystal display panels.

[0020]

Next, describing a process of forming the color filter and the projections and recesses 20 on one glass substrate 1 in conjunction with FIG. 2 illustrating a manufacturing process of the color filter substrate, in FIG. 2(a) illustrating a process of forming a color filter, a color filter 6 is deposited on the glass substrate 1 to form a step, in FIG. 2(b) illustrating a process of forming an overcoat layer, an overcoat layer 7 is formed on the glass

substrate 1 and the color filter 6, in FIG. 2(c) illustrating a process of etching the overcoat layer, the overcoat layer 7 is etched to form the projections and recesses 20 on the color filter substrate, in FIG. 2(d) illustrating a process of forming a transparent electrode, a transparent electrode 8 is formed on the overcoat layer 7, and in FIG. 2(e) illustrating a process of etching the glass substrate, the glass substrate 1, which is not covered with the transparent electrode 8 at portions of the projections and recesses 20, is etched to form grooves 21 so that a height difference between the projections and recesses 20 becomes larger and a thickness of the glass substrate 1 at which the etching is performed becomes smaller, thereby easily cutting the glass substrate 1.

[0021]

Next, describing a process of forming the pattern forming part and the projections and recesses 20 on the other glass substrate 1 in conjunction with FIG. 3 illustrating a process of manufacturing the array substrate, in FIG. 3(a) illustrating a process of forming a pattern (a gate electrode forming process), a pattern forming art 19 including a thin film transistor, a transparent electrode, and an IC mounting part is formed on the glass substrate 1, in FIG. 3(b) illustrating a process of forming an insulating layer, an insulating layer 11 is formed on the glass

substrate 1 and the pattern forming part 10, in FIG. 3(c) illustrating a process of etching the insulating layer (a contact hole forming process), the insulating layer 11 is etched and removed during the process of forming a contact between a gate electrode and a source electrode of the pattern forming part to form the projections and recesses 20 on the array substrate, and in FIG. 3(d) illustrating a process of etching the glass substrate, the glass substrate 1, which is not covered with the insulating layer 11 at portions of the projections and recesses 20, is etched to form grooves 22 so that a height difference between the projections and recesses 20 becomes larger and a thickness of the glass substrate 1 at which the etching is performed becomes smaller, thereby easily cutting the glass substrate 1, similarly to the process of etching the glass substrate in FIG. 2(e).

[0022]

Next, as shown in FIGS. 4(a), (b) and (c), which are cross-sectional views taken along line A-A of FIG. 1, the sealant 3 is applied between the color filter substrate 23 and the array substrate 24 manufactured using the above-mentioned method to adhere to each other, and the sealant 3 sequentially moves as shown in FIGS. 4(a), (b) and (c), during the process of dividing the substrate into a plurality of individual liquid crystal display panels 4.

[0023]

First, in the first step, as shown in FIG. 4(a), spacers 13 are interposed between the color filter substrate 23 and the array substrate 24 to maintain a predetermined gap therebetween, and the sealant 3 is applied on the color filter substrate 23 using a dispenser to seal a liquid crystal in the image display part 2. An injection port 5 is formed to inject the liquid crystal into the image display part 2 when the sealant 3 is applied. At this time, if the sealant 3 is applied using the dispenser, a seal boat 15 is formed at an outside of an injection port forming part 14, i.e., unnecessary parts between the adjacent liquid crystal display panels 4.

[0024]

Next, in the second step, as shown in FIG. 4(b), uniform pressure is applied onto an entire surface of the color filter substrate 23 and the array substrate 24 in the state of FIG. 4(a), and a gap between the substrates is uniformly maintained in 5 μm. At this time, if a height difference between the projections and recesses 20 formed at the color filter substrate 23 is 1.2 μm and a height difference between the projections and recesses 20 formed at the array substrate 24 is 2.0 μm, a minimum gap between the substrates is about 1.8 μm. Further, grooves 21 are formed by etching 100 μm at the glass substrate 1 of the

projections and recesses 20 of the color filter substrate 23, and grooves 22 are formed by etching 100 μm at the glass substrate 1 of the projections and recesses 20 of the array substrate 23, thereby more increasing the height difference between the projections and recesses 20.

[0025]

When the color filter substrate 23 and the array substrate 24 are adhered to each other, as shown in FIG. 4(b), the flexible sealant 3 and seal boat 15 expand in a certain direction along the projections and recesses 20 due to the gap of about 1.8 μm and the height difference of about 100 μm not to intrude into the adjacent liquid crystal display panel, thereby curing the sealant 3 in this state.

[0026]

Next, in the third step, as shown in FIG. 4(c), the liquid crystal display panels are individually divided along the lines B-B, C-C and D-D of FIG. 4(b), divided liquid crystal display panels 25 and 26 are obtained at a left side of the line B-B and a right side of the lines C-C and D-D, and the unnecessary part 27 having the seal boat 15 is separated between the line B-B and the lines C-C and D-D. However, when the unnecessary part 27 is separated, since the seal boat 15 of the unnecessary part 27 does not intrude into the adjacent liquid crystal display panel 4, there is no probability of separating the pattern forming part 10 of

the adjacent liquid crystal display panel 4 together with the seal boat 15 of the unnecessary part 27.

[0027]

As described above, in accordance with the method of manufacturing the liquid crystal display panel of the embodiment of the present invention, since the projections and recesses 20 and the grooves 21 and 22 formed at portions of the projections and recesses 20 are formed on the pair of glass substrates 1 to surround the individual liquid crystal display panels 4, when the color filter substrate 23 and the array substrate 24 are adhered to each other, the sealant 3 and the seal boat 25 applied between the substrates move along the projections and recesses 20 to prevent them from irregularly expanding, and when the individual liquid crystal display panels 4 and the unnecessary parts 27 are separated, it is possible to prevent the pattern forming part 10 of the adjacent liquid crystal display panel 4 from being improperly cut.

[0028]

[Effects of the Invention]

As described above, in accordance with the method of manufacturing the liquid crystal display panel of the embodiment of the present invention, it is possible to prevent the sealant from intruding into the pattern forming part of the adjacent liquid crystal display panel to remove

the improper cutting of the pattern forming part and therefore reduce yield loss, when the sealant is applied around the plurality of image display parts between the pair of substrates including the liquid crystal interposed therebetween, and then the substrates are adhered to each other by the projections and recesses which are formed at the substrate to surround the individual liquid crystal display panels formed of the image display part and the sealant surrounding the image display part.

[0029]

In addition, since the space between the adjacent liquid crystal display panels can be narrowed, it is possible to increase the size of the panel, and further, it is possible to increase productivity by increasing the number of liquid crystal display panels divided from one substrate.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a plan view of a liquid crystal display panel in a first step of a process of manufacturing a liquid crystal display panel in accordance with an embodiment of the present invention.

[FIG. 2]

FIG. 2 is a view illustrating a process of manufacturing a color filter substrate in a method of

manufacturing a liquid crystal display panel in accordance with an embodiment of the present invention.

[FIG. 3]

FIG. 3 is a view illustrating a process of manufacturing an array substrate in a method of manufacturing a liquid crystal display panel in accordance with an embodiment of the present invention.

[FIG. 4]

FIG. 4 is a cross-sectional view taken along line A-A of FIG. 1.

[FIG. 5]

FIG. 5 is a plan view of a liquid crystal display panel in a first step of a conventional method of manufacturing a liquid crystal display panel.

[FIG. 6]

FIG. 6 is a cross-sectional view taken along line A-A of FIG. 5.

[Reference Numerals]

1: glass substrate

2: image display part

3: sealant

4, 17, 18, 25, 26: liquid crystal display panels

5: injection port

6: color filter

7: overcoat layer

12, 24: array substrate

13: spacer

14: injection port forming part

15: seal boat

16: intruded seal part

19, 27: unnecessary parts

20: projections and recesses

21, 22: grooves